PLANT ITEM MATERIAL SELECTION DATA SHEET

R10630666

HDH-VSL-00003 (HLW)

Waste Neutralization Vessel

ISSUED BY
RPP-WTP PDC

- Design Temperature (°F) (max/min): 237/16
- Design Pressure (psig) (max/min): 15/FV
- Location: out cell

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheets 5 and 6

Operating Modes Considered:

- The vessel is filled with the acidic decontamination solution at normal operating temperature.
- The vessel reaches a maximum operating temperature of 212°F.
- Off-normal conditions assume that raw ceric nitrate is accidentally sent to HDH-VSL-00002 and recovery involves transferring the $Ce(NO_3)_4$ into HDH-VSL-00003 for neutralization.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00	X	
316L (S31603)	1.18		X
6% Mo (N08367/N08926)	7.64		X
Alloy 22 (N06022)	11.4		X
Ti-2 (R50400)	10.1		X

Recommended Material: 304 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: 0.04 inch (includes 0.024 inch corrosion allowance and 0.016 inch erosion allowance)

Process & Operations Limitations:

- H_2O_2 must be present prior to or be introduced concurrently with the decontamination waste from HDH-VSL-00002.

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EXPIRES: 12/07/05

9/15/05

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This bound document contains a total of 6 sheets.

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Corrosion Considerations:

This vessel is a holding point for the neutralization of the spent decontamination solution, steam condensate, nitric acid and demineralized water rinses from the canister decontamination vessel as well as rinse water from HDH-VSL-00001 prior to transfer to the PT facility.

a General Corrosion
During normal operation, the cerium IV will mostly be consumed in the canister decon vessel and what is not will be rapidly destroyed by the peroxide in the neutralization vessel. Under these circumstances, 304L would be a suitable vessel material. Corrosion rates of 304 stainless steel in Ce-IV/nitric acid solutions depend on temperature, nitric acid concentration, and cerium concentration, but are typically about 350 mpy. Thus, the solution containing Ce^{+4} is good for decontamination of stainless steel and therefore cannot be stored in stainless steel containers. If it were assumed that 1% of the Ce^{+4} remains when the solution reaches HDH-VSL-00003 and it is present for 40 years corroding stainless steel, then a stainless vessel would suffer about a 3 mpy corrosion rate or about 120 mil. However, because the Ce IV is diluted in the 304L vessel and rapidly neutralized, little corrosion is expected.

It is estimated that if an unused, undiluted batch of Ce IV is put into the 304L vessel and not neutralized twice a year, very little vessel corrosion would occur. According to Bray (1988, 1992), the amount of Ce^{+4} in a given batch is sufficient to remove less than 10 μm of stainless steel. If this occurs twice a year for 40 years, then about 800 μm (32 mil) would be consumed. This is less than the recommended corrosion allowance of 40 mils. Therefore, 304L is satisfactory.

According to Davis (1987), acid peroxide solutions corrode Ti-2 at rates of up to 30 mpy. Leaks of acid peroxide into a Ti-2 vessel would be deleterious.

Conclusion:
Based on relative corrosion rates and the worse case operating conditions, 304L or 316L can be used.

b Pitting Corrosion
In this system, there should be no chloride except for that brought over with any ^{137}Cs contamination. This should amount only to 0.13 Ci of ^{137}Cs, equivalent to about 1.5 mg of Cs and therefore 0.4 mg of chloride. With approximately 800 L of solution, the chloride is expected to be about 0.5 ppb.

Pitting of 304L is not expected to be a concern because of the low chloride concentration and the high nitrate concentration.

Conclusion:
Pitting of 304L is not considered a problem with the proposed solution.

c End Grain Corrosion
No published data, but not expected to be a concern. 304L stainless steel is acceptable for the vessel and no attack is expected.

Conclusion:
Not likely in this system.

d Stress Corrosion Cracking
Cracking is not a concern at the stated conditions; there is too much nitrate and too little chloride. It has been shown that post-decontamination cracking of the canister is not a concern and this vessel sees similar conditions. Therefore, 304L is suitable.

Conclusion:
304L is acceptable.

e Crevice Corrosion
See Pitting.

Conclusion:
See Pitting

f Corrosion at Welds
None anticipated.

Conclusion:
Weld corrosion is not considered a problem.

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g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are not conducive to microbial growth.

Conclusion:
MIC is not considered a problem.

h Fatigue/Corrosion Fatigue
Corrosion fatigue is not expected to be a problem.

Conclusions
Not a problem.

i Vapor Phase Corrosion
Not expected to be a problem.

Conclusion:
Not expected to be a problem.

j Erosion
Velocities within the vessel are expected to be small. A general erosion allowance of 0.016 inch is adequate for components with solids content less than 27.3 wt%.

Conclusion:
Not expected to be a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No contacting surfaces expected.

Conclusion:
Not applicable.

m Galvanic Corrosion
Not a problem.

Conclusion:
Not a problem.

n Cavitation
None expected.

Conclusion:
Not a concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

p Inadvertent Addition of Nitric Acid
Vessel receives nitric acid during normal operations.

Conclusion:
Not applicable.

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References:

1. 24590-WTP-RPT-M-04-0008, Rev. 2, *Evaluation Of Stainless Steel Wear Rates In WTP Waste Streams At Low Velocities*
2. 24590-WTP-RPT-PR-04-0001, Rev. B, *WTP Process Corrosion Data*
3. Bray , LA, 1988, *Development of a Chemical Process Using Nitric Acid-Cerium (IV) for Decontamination of High-Level Waste Canisters*, Battelle, Pacific Northwest Laboratory, Richland, WA 99352
4. Bray, LA, MR Elmore, KJ Carson, RJ Elovich, GM Richardson, and LD Anderson, 1992, *Decontamination Testing of Radioactive-Contaminated Stainless Steel Coupons Using a Ce(IV) Solution*, Battelle, Pacific Northwest Laboratory, Richland, WA 99352
5. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
6. Mackey, DB Personal communication to JR Divine, 24 March, 2000
7. Meigs, R, Personal communication to D E Larson, 22 March 2000, amount of soluble Cs on the canister.

Bibliography:

1. Craig, BD, Editor, 1989, *Handbook of Corrosion Data*, ASM International, Metals Park, OH 44073
2. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073

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OPERATING CONDITIONS

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Waste neutralization vessel (HDH-VSL-00003)

Facility HLW

In Black Cell? No

Chemicals	Unit[1]	Contract Maximum		Non-Routine (Note 5)		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	1.12E-03	1.87E-03	1.15E-03	1.92E-03	
Chloride	g/l					
Fluoride	g/l					
Iron	g/l	7.18E-01	7.16E-01	7.39E-01	7.37E-01	
Nitrate	g/l	7.64E+01	7.64E+01	2.42E+02	2.42E+02	
Nitrite	g/l					
Phosphate	g/l					
Sulfate	g/l					
Mercury	g/l					
Carbonate	g/l					
Undissolved solids	wt %	0.70%	0.70%	5.45%	5.45%	
Other (H2O2)	g/l	3.14E+02	3.14E+02	2.23E-04	1.69E-04	Note 2
Other (Cerium)	g/l	6.22E+00	6.22E+00	6.81E+01	6.81E+01	Note 3
pH	N/A					
Temperature	°F					Note 4
						Note 5

List of Organic Species:

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. 30 wt% hydrogen peroxide is added as a reagent to deactivate cerium nitrate.
3. HDH-VSL-00002/4 overflow to this vessel and contain cerium nitrate, nitric acid.
4. Tmin 59 °F (BOD), Tnorm 113 °F.
5. HDH-VSL-00002 and HDH-VSL-00004 overflow to this vessel .

Assumptions

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5.2.5 Waste Neutralization Vessel (HDH-VSL-00003)

Routine Operations

The waste neutralization vessel (HDH-VSL-00003) is used as a holding point for the neutralization of the spent decontamination solution from the canister decontamination vessel, steam condensate, nitric acid

and demineralized water rinses from the canister decontamination vessel, steam jet dilution, and wash water from the rinse tunnel canister rinse vessel (HDH-VSL-00001) prior to transfer to the PT facility. The waste neutralization vessel is equipped with service piping for demineralized water and process air, ventilation, level, temperature, and pressure transmitters, three steam ejectors (dual ejectors to the RLD-VSL-00007 and one to completely empty the waste neutralization vessel to the plant wash and drains vessel (RLD-VSL-00008), an overflow line, nozzles for the canister decontamination vessel's overflow and steam condensate, effluents from the canister decontamination vessels (HDH-VSL-00002/4) and rinse tunnel canister rinse vessel (HDH-VSL-00001), hydrogen peroxide and NaOH addition.

Non-Routine Operations that Could Affect Corrosion/Erosion

- HDH-VSL-00002 overflows to this vessel.
- HDH-VSL-00004 overflows to this vessel.